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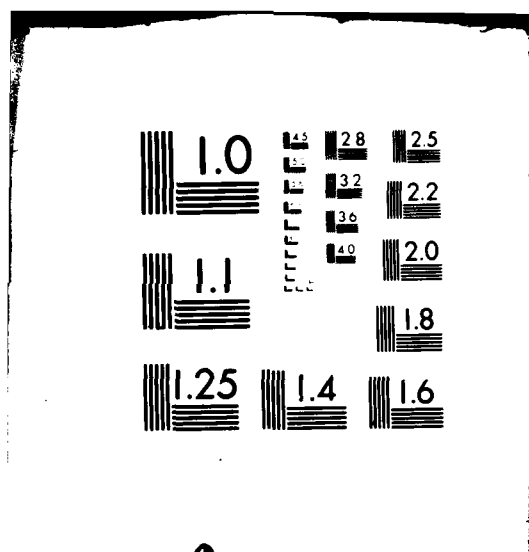
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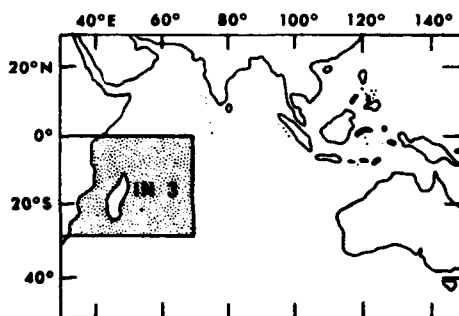
NAVAL OCEANOGRAPHIC OFFICE SPECIAL PUBLICATION 1404—IN 3

# SURFACE CURRENTS

WEST CENTRAL INDIAN OCEAN  
INCLUDING MOZAMBIQUE CHANNEL

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## **ABSTRACT**

THIS ATLAS, AND THE SERIES OF WHICH IT IS A PART, IS COMPUTER GENERATED AND AUTOMATICALLY PLOTTED. IT MAKES AVAILABLE TO THE USER THE MOST RECENT SURFACE CURRENT DATA COLLECTED AND WILL BE UPDATED WHENEVER SUFFICIENT AMOUNTS OF DATA ARE ADDED TO THE DATA FILE. THIS AND THE OTHER ATLASES ARE BASED ON A VAST QUANTITY OF DATA AS COMPARED TO THE PREVIOUS MANUALLY-COMPILED EDITIONS PRINTED IN THE MID-THIRTIES.

THE SURFACE CURRENT INFORMATION IS BASED MAINLY ON SHIP DRIFT, WHICH IS THE DIFFERENCE BETWEEN THE DEAD RECKONING POSITION AND THE POSITION DETERMINED BY ANY TYPE OF NAVIGATIONAL FIX. THIS DIFFERENCE DESCRIBES THE DIRECTION AND SPEED OF THE CURRENT.

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# SURFACE CURRENTS

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# SURFACE CURRENTS .

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#### **ACKNOWLEDGMENTS**

**Messrs. Raymond J. Beauchesne\* and William E. Boisvert made major contributions to this atlas.**


**\*Mr. Beauchesne presently is employed by the Bureau of Naval Personnel.**



## FOREWORD

THIS ATLAS, ONE IN A SERIES OF 43 REGIONAL SURFACE CHARTS, IS PRODUCED TO FULFILL A NEED OF NAVY PLANNING STAFFS AND THE MARITIME INDUSTRIAL COMMUNITIES FOR THE LATEST AVAILABLE OCEAN SURFACE CHARTS. THESE ATLASES ADD TO THE WEALTH OF NAUTICAL INFORMATION UPON WHICH NAUTICAL PLANNING, NAVIGATIONAL SAFETY, AND SHIPPING ECONOMY DEPEND. THE PRODUCTION AND WIDE DISSEMINATION OF THIS ATLAS ARE MADE POSSIBLE BY THE LATEST COMPUTER TECHNIQUES.

THE CONSTANT IMPROVEMENT IN THE QUALITY OF SURFACE CHARTS RECEIVED OVER THE YEARS IS MADE POSSIBLE LARGELY BY THE MORE THOROUGH OBSERVATIONS OF VOLUNTARY OBSERVERS IN RECENT YEARS. THE DEFENSE MAPPING AGENCY, THE OCEANOGRAPHIC OFFICE, AND THE USER OF THE ATLASES RELY ON THE PERSISTENT OBSERVATIONS OF THE MAN WHO HAS "BEEN THERE." MARINERS, IN REPORTING OBSERVATIONS, RENDER A SERVICE NOT ONLY TO THEMSELVES BUT ALSO TO THOSE WHO GO DOWN TO THE SEA IN SHIPS." WITH THE ADVENT OF NUCLEAR POWER, NAVIGATION AIDS, AND 300,000-TON SHIPS, UP-TO-DATE, RAPIDLY DISSEMINATED ENVIRONMENTAL AND NAVIGATIONAL INFORMATION HAS BECOME INCREASINGLY IMPORTANT.

  
JOHN R. McDONNELL  
Captain, U.S. Navy  
Commander

## FOREWORD

A SERIES OF 43 REGIONAL SURFACE CURRENT ATLASES, ED OF NAVY PLANNING STAFFS AND THE SCIENTIFIC AND THE LATEST AVAILABLE OCEAN SURFACE CURRENT DATA. ALTH OF NAUTICAL INFORMATION UPON WHICH OPERA- AL SAFETY, AND SHIPPING ECONOMY DEPEND. RAPID NATION OF THIS ATLAS ARE MADE POSSIBLE BY THE

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*John R. McDonnell*  
JOHN R. McDONNELL  
Captain, U.S. Navy  
Commander

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## SURFACE CURRENT ATLASES

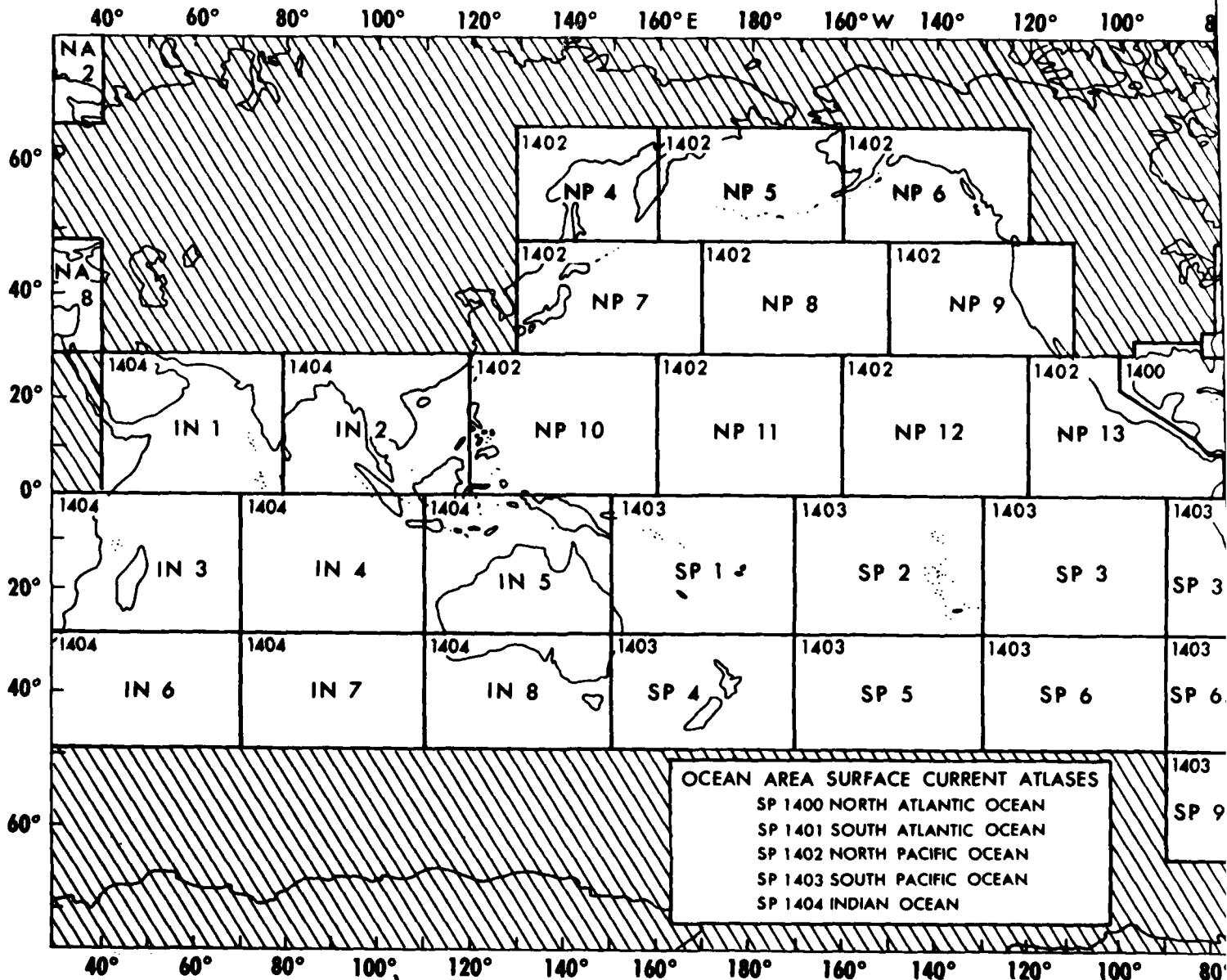
THIS SERIES OF COMPUTERIZED ATLASES REPLACES THE U. S. HYDROGRAPHIC OFFICE ATLASES OF SURFACE CURRENTS (HOP 566, 568, 569, 570) WHICH WERE MANUALLY COMPILED FROM DATA OBTAINED DURING THE PERIOD 1908 - 1934. THESE NEW ATLASES CONFORM TO THE STANDARD NAVY OCEAN AREA AND REGION INDEX LIMITS SHOWN BELOW: e.g., NOO SP 1402-NP 10 COVERS NORTH PACIFIC REGION 10 EAST OF THE PHILIPPINES.

AS AMOUNTS OF NEW DATA

THESE GRAPHICS MAY AREAS AS THE NORTH SEA. CURRENTS ARE STRONGLY IN PREDICTABLE HOURLY CHAN

RECENT IMPROVEMENTS IN THE DATA FILE ASSURE THE INCLUSION OF THE LATEST, HIGH QUALITY SURFACE CURRENT DATA AVAILABLE. THE FILE NOW CONTAINS MORE THAN 4,200,000 OBSERVATIONS AND A GENERAL UPDATE OF THE FILE WILL BE MADE

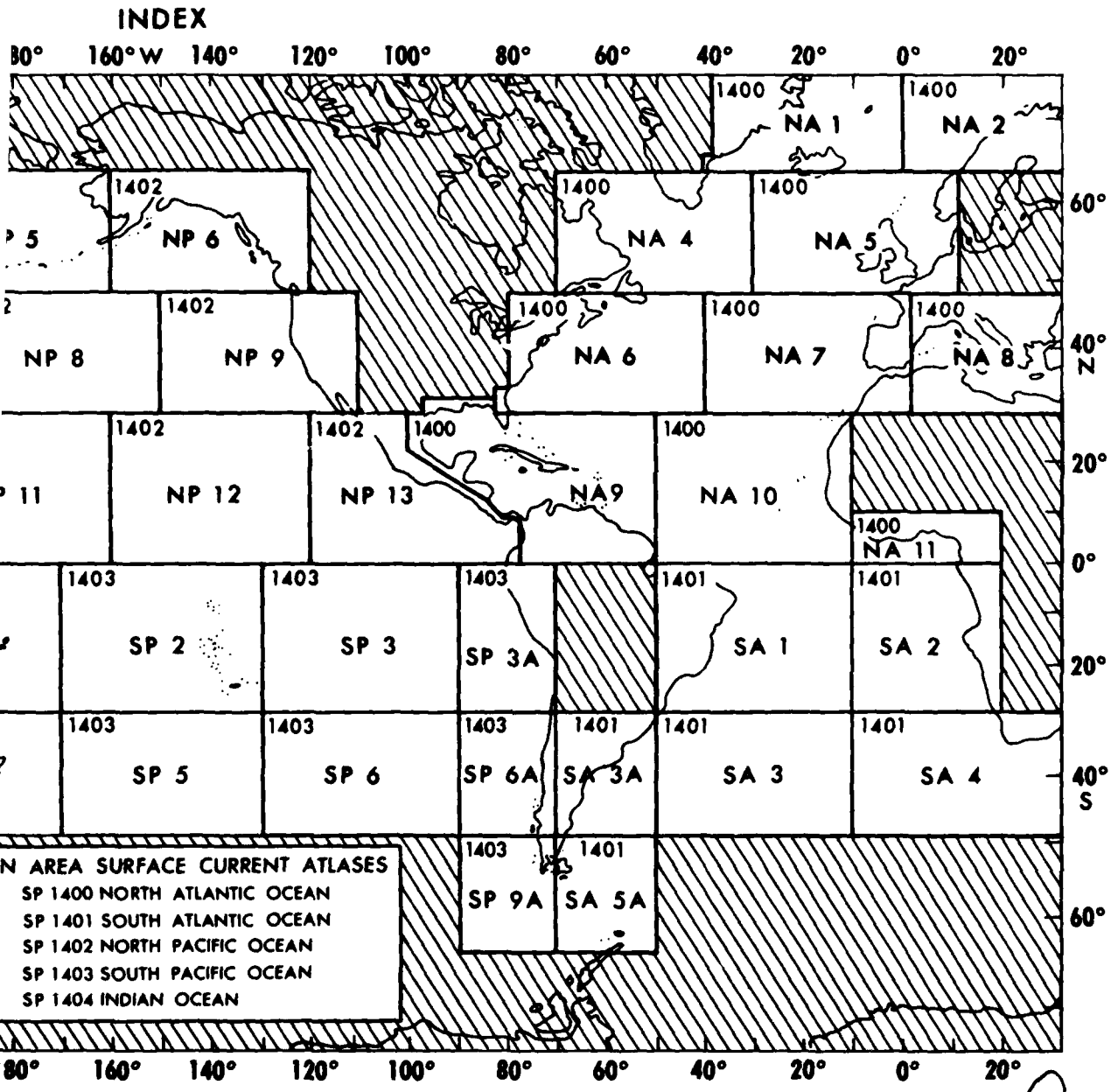
### INDEX



**IFACE CURRENT ATLASES**

FIGURE 1 AS AMOUNTS OF NEW DATA WARRANT, MOST LIKELY EVERY 12 - 18 MONTHS.  
 THESE GRAPHICS MAY NOT BE TRULY REPRESENTATIVE OF THE ACTUAL FLOW IN SUCH  
 AREAS AS THE NORTH SEA, PERSIAN GULF, GULF OF THAILAND, AND YELLOW SEA WHERE  
 CURRENTS ARE STRONGLY TIDAL. FOR SUCH AREAS, OTHER SOURCES DESCRIBING  
 PREDICTABLE HOURLY CHANGES OF TIDAL CURRENTS SHOULD BE CONSULTED.

ST.



## Introduction

The Surface Current Data File, from which these atlases are derived, consists primarily of over four million ship set and drift observations. These data were collected by the Netherlands, Japan, Britain, France, and the United States. The file is supplemented by several thousand Geomagnetic Electrokinetograph (GEK) observations, mostly Japanese. The file spans the period from the early 1850's to the present. The earliest observations were collected by the Netherlands and Great Britain; those of the 1960's through the present are primarily United States data.

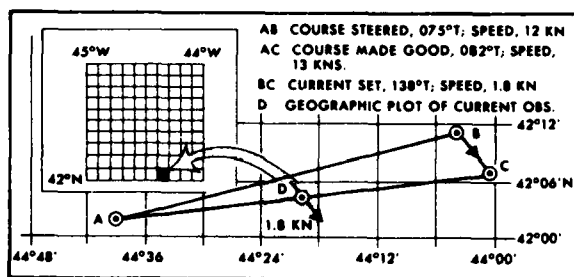
## General Quality

The quality of this data file is considered high for this type of derived value. The data have been carefully screened for duplication; observations taken under adverse conditions (i.e. high winds and waves, time between observations greater than 12 hours) have been eliminated when warranted. Consideration was given to the reliability of the observer; doubtful shipboard computations of set and drift were edited; and observations with erroneous locations (mostly observations on land) have been eliminated. The accepted data are considered most useful when used collectively as in summaries where a number of observations show trends.

## General Observation Technique

The set (direction) and drift (speed) are computed by the navigator from the difference between the dead reckoning (DR) position and the position determined by any type of navigational fix. The drift can be determined along any straight line track and includes all factors which cause changes in the DR position. When a fix is obtained, the current set (direction) is FROM the DR position TO the fix; the drift (speed) is equal to the distance in nautical miles between the DR and the fix, divided by the number of hours since the last fix. For successive observations, the TO POSITION of one observation becomes the FROM POSITION of the next observation.

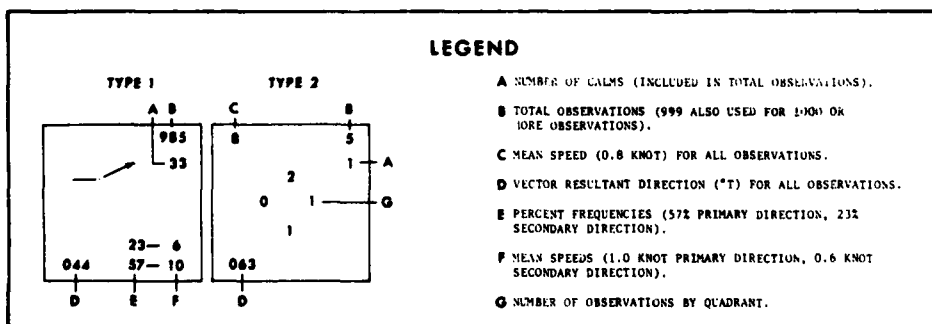
Because the influence of current may vary along a ship's track, the MEAN POSITION of the track is assigned as the geographic location of the current observation. An example of a current computation is shown in the figure below.



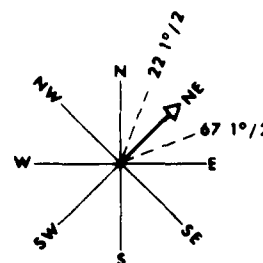
EXAMPLE OF A SURFACE CURRENT (SHIP'S DRIFT) OBSERVATION

## Data Presentation

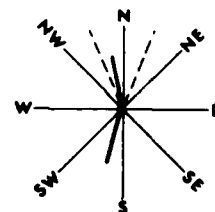
The following legend shows two types of surface current presentations by 1° quadrangle, type 1 with 12 or more observations and type 2 with fewer than 12 observations. Where there are 11 or fewer observations within a 1° quadrangle, the total number of observations is shown within the 90° quadrant containing the observations.



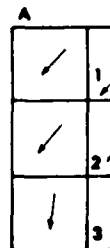
If there are 12 or more observations by vector resultants as follows:



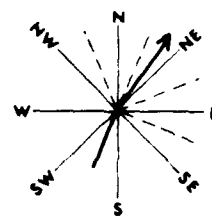
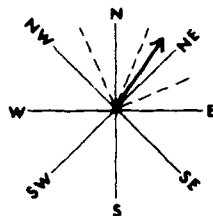
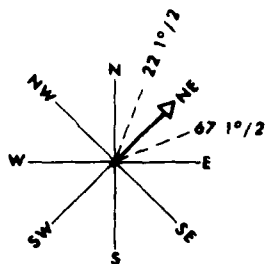
- (1) Persistent Current - 60 percent or more of all observations fall within a 45° sector of the 8-point compass. (2) Prevailing Current - 45°



- (4) Bizonal Flow - Practically all observations are concentrated in opposite pairs of sectors, and one pair contains at least 80 percent as many observations as the other pair. This generally indicates var that occurs in zones of entrainment opposing currents (see examples A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z).



If there are 12 or more observations in a 1° quadrangle, the surface current is depicted by vector resultants as follows:

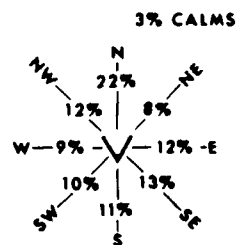
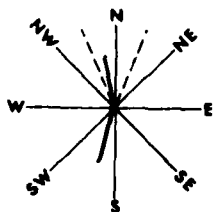


(1) **Persistent Current** - 60 percent or more of all observations fall within a 45° sector of the 8-point compass.

(2) **Prevailing Current** - 70 percent or more of all observations fall within two adjacent 45° sectors.

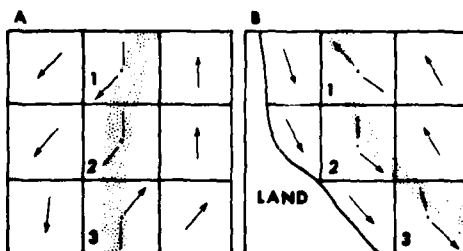
(3) **Primary Current with Secondary Direction** -  
(a) **Primary Current** - 50 percent or more of all observations fall within three adjacent 45° sectors.

(b) **Secondary Direction** - 20 percent or more of all observations fall within a 45° sector, and the two resultant vector directions are separated by more than 90° of arc.



(4) **Bizonal Flow** - Practically all observations are concentrated in opposite pairs of 45° sectors, and one pair contains at least 80 percent as many observations as the opposite pair. This generally indicates variability that occurs in zones of entrainment between opposing currents (see examples A and B, quadrangles 1, 2, and 3).

(5) **Variable Current** - The 45° sector with most observations has less than 25 percent of all observations; direction is indeterminate.



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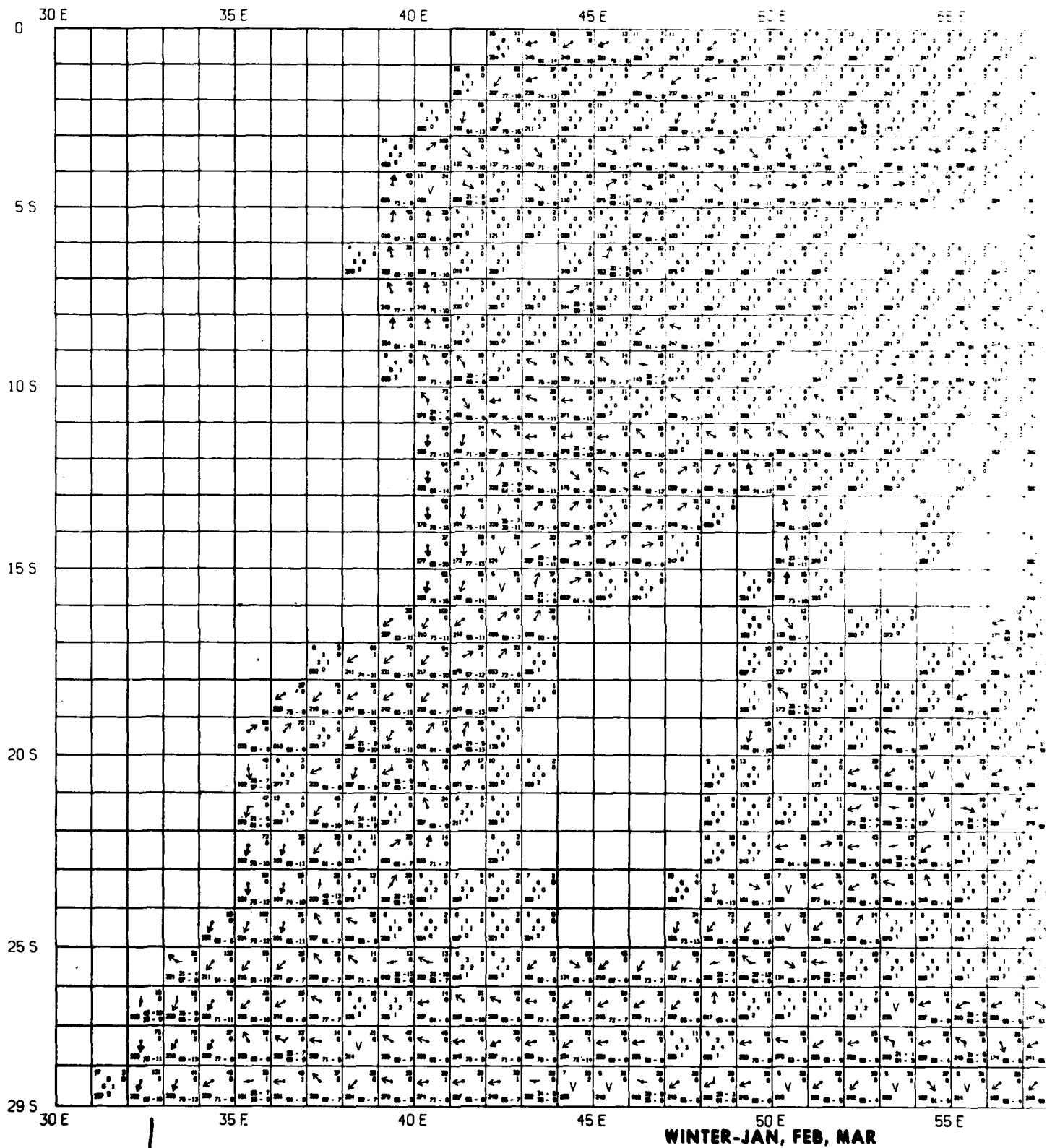
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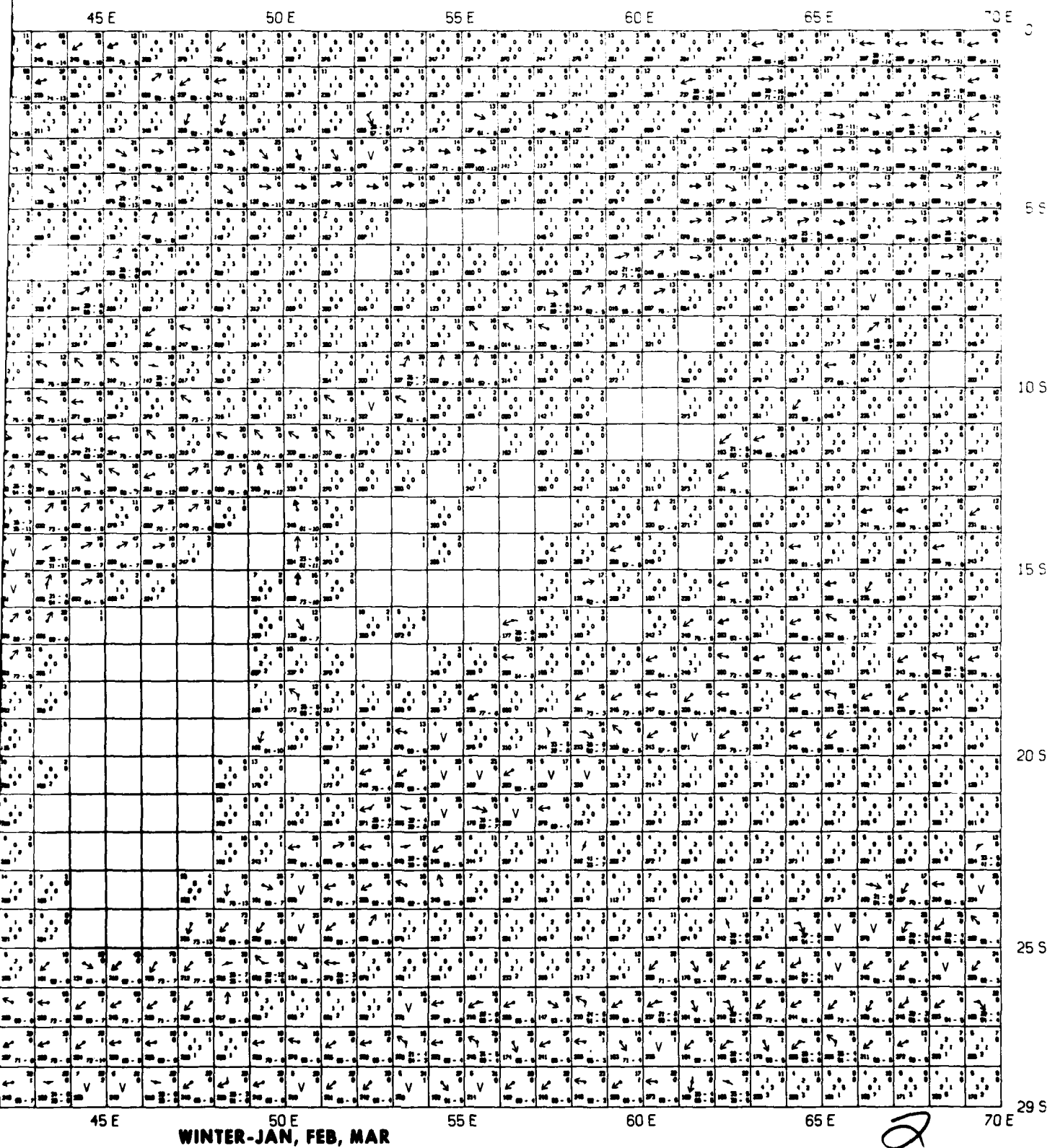
FOR ALL OBSERVATIONS.

DIRECTION, 21%

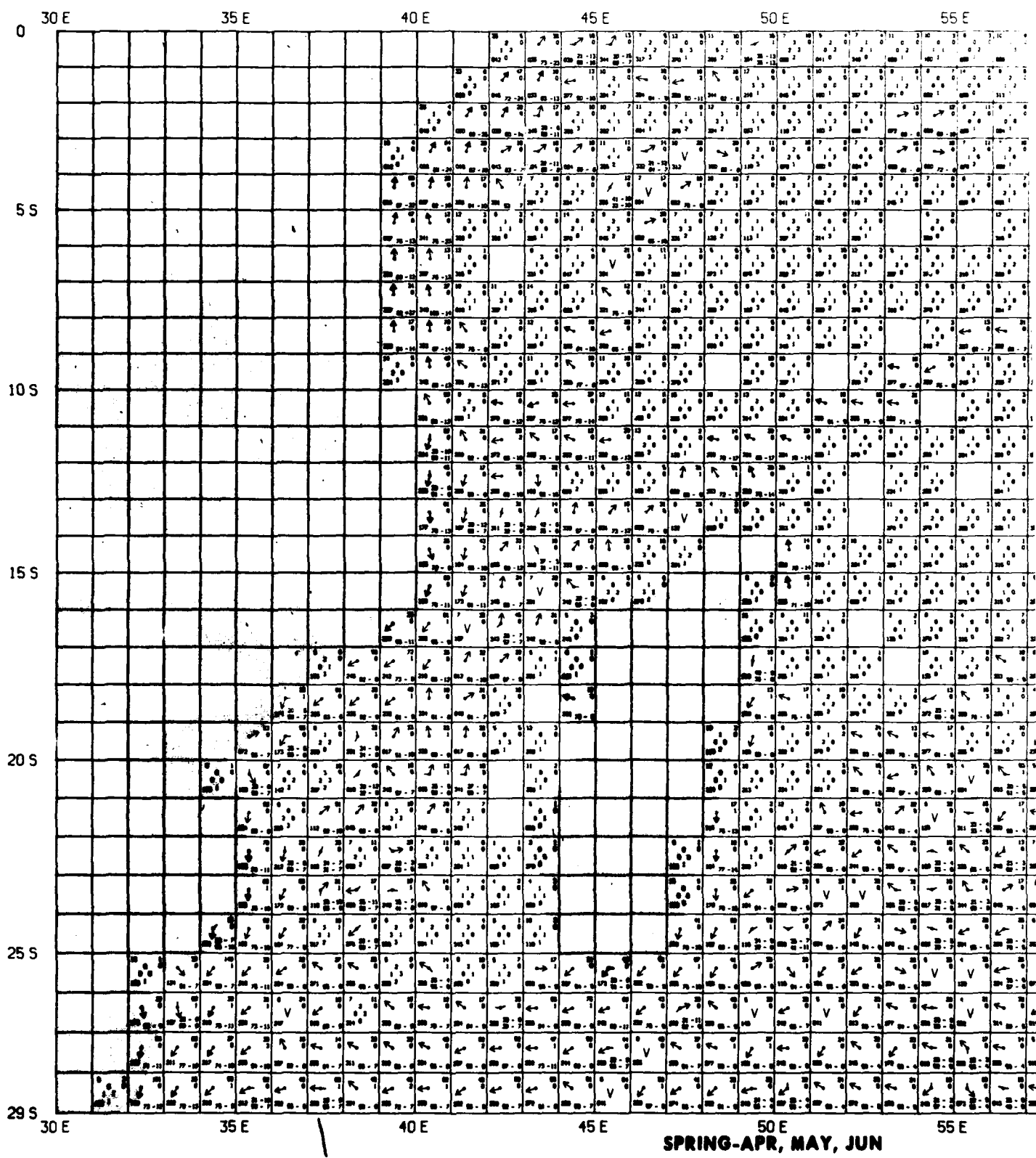
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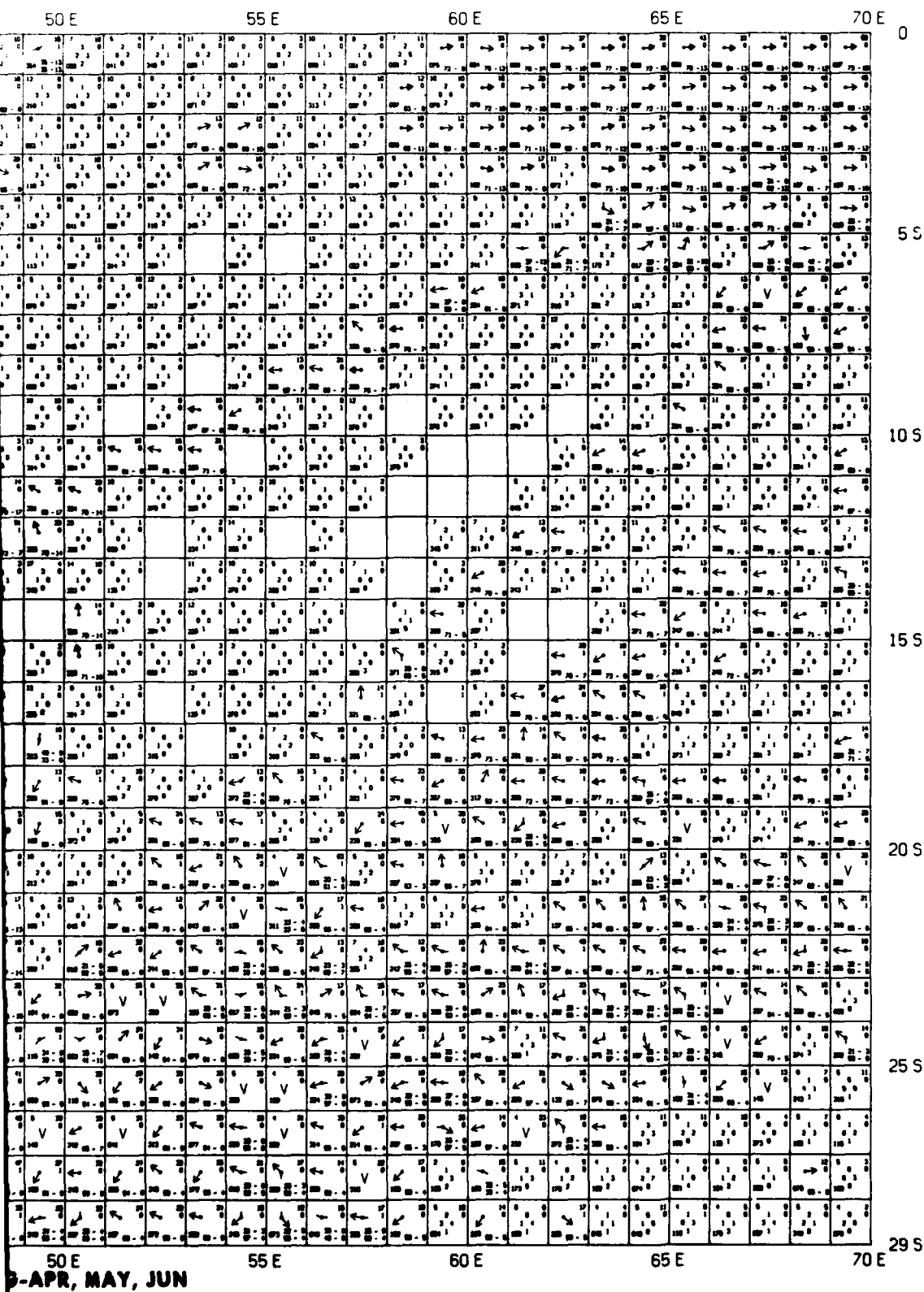
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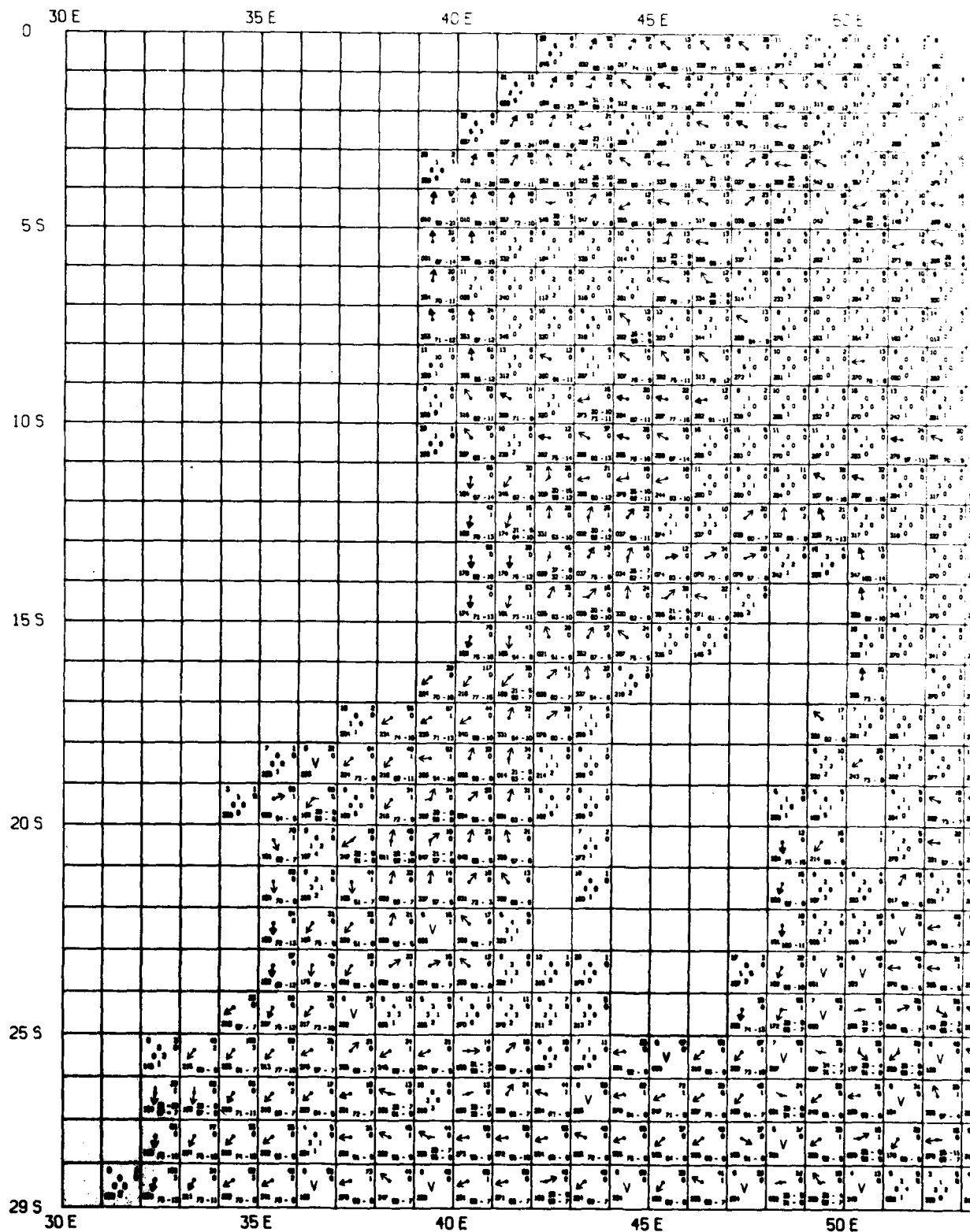




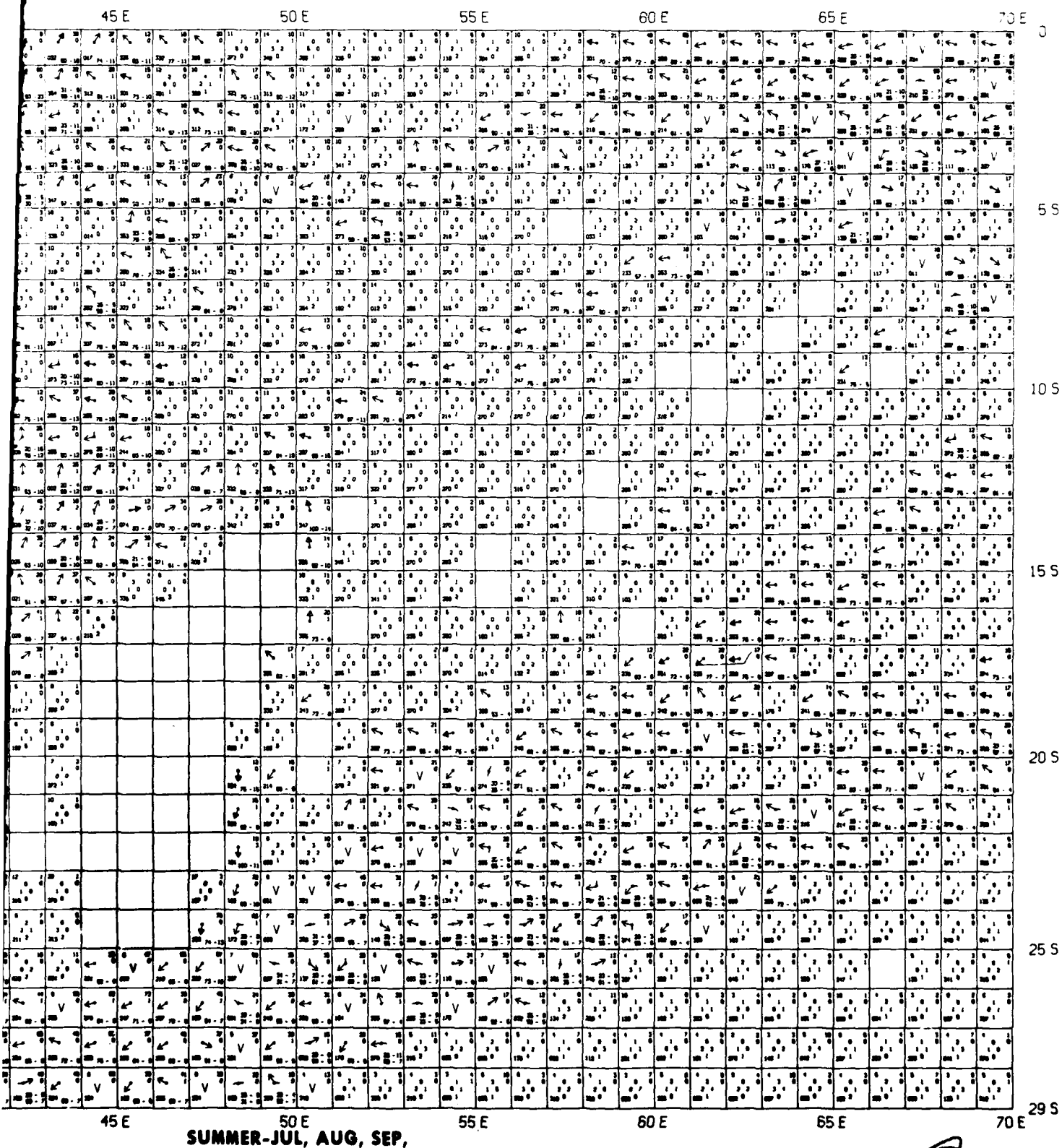


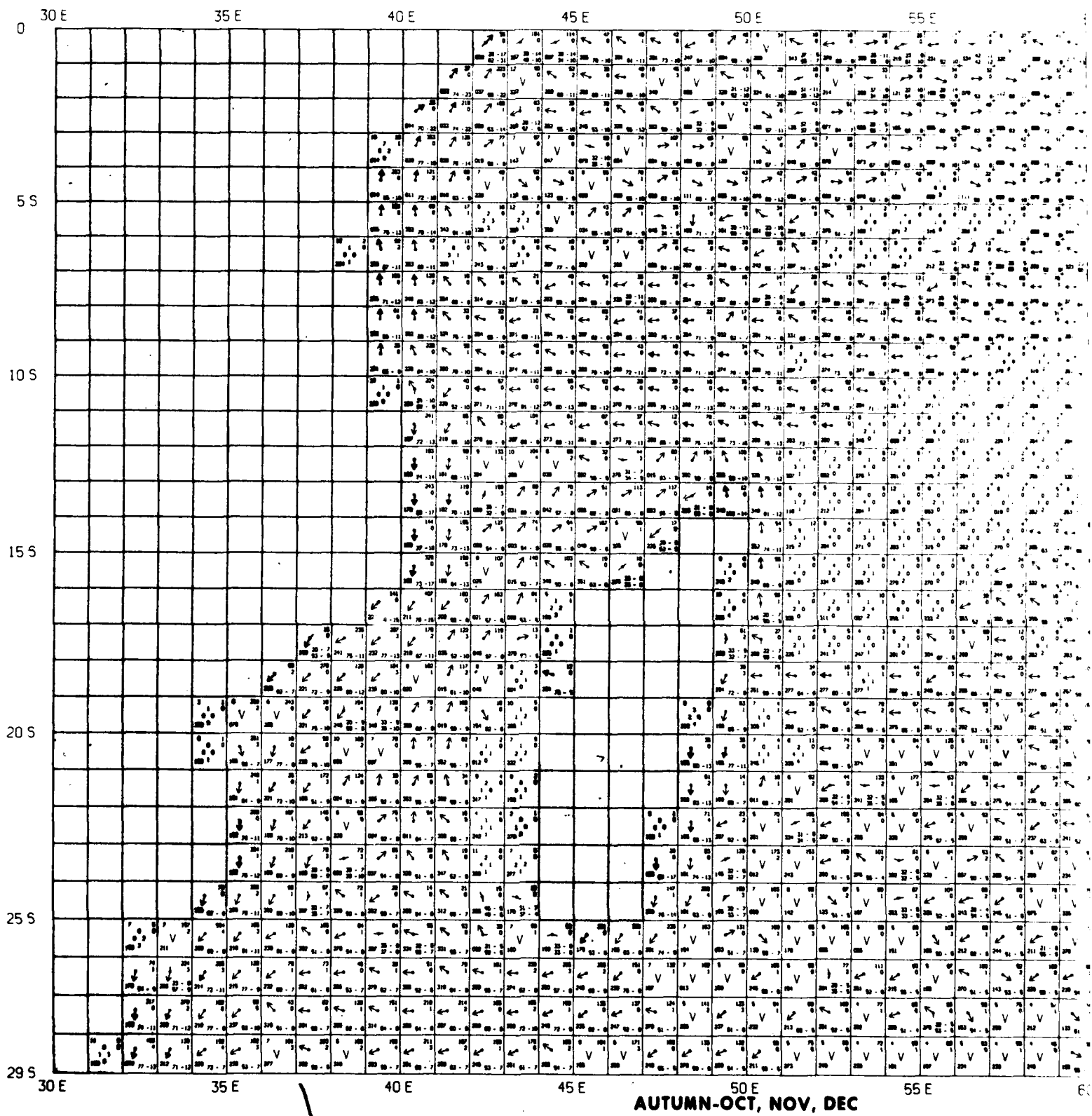


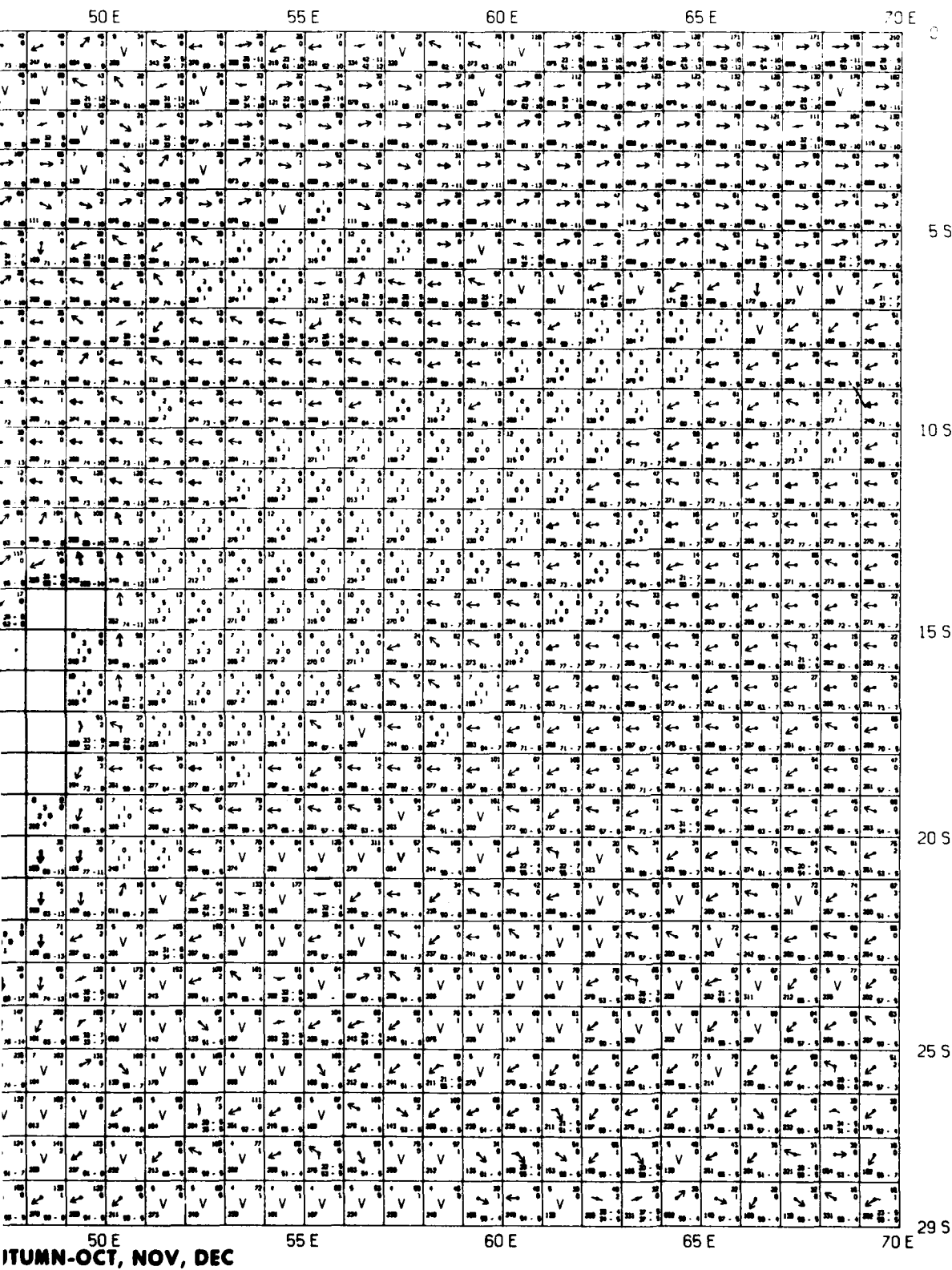




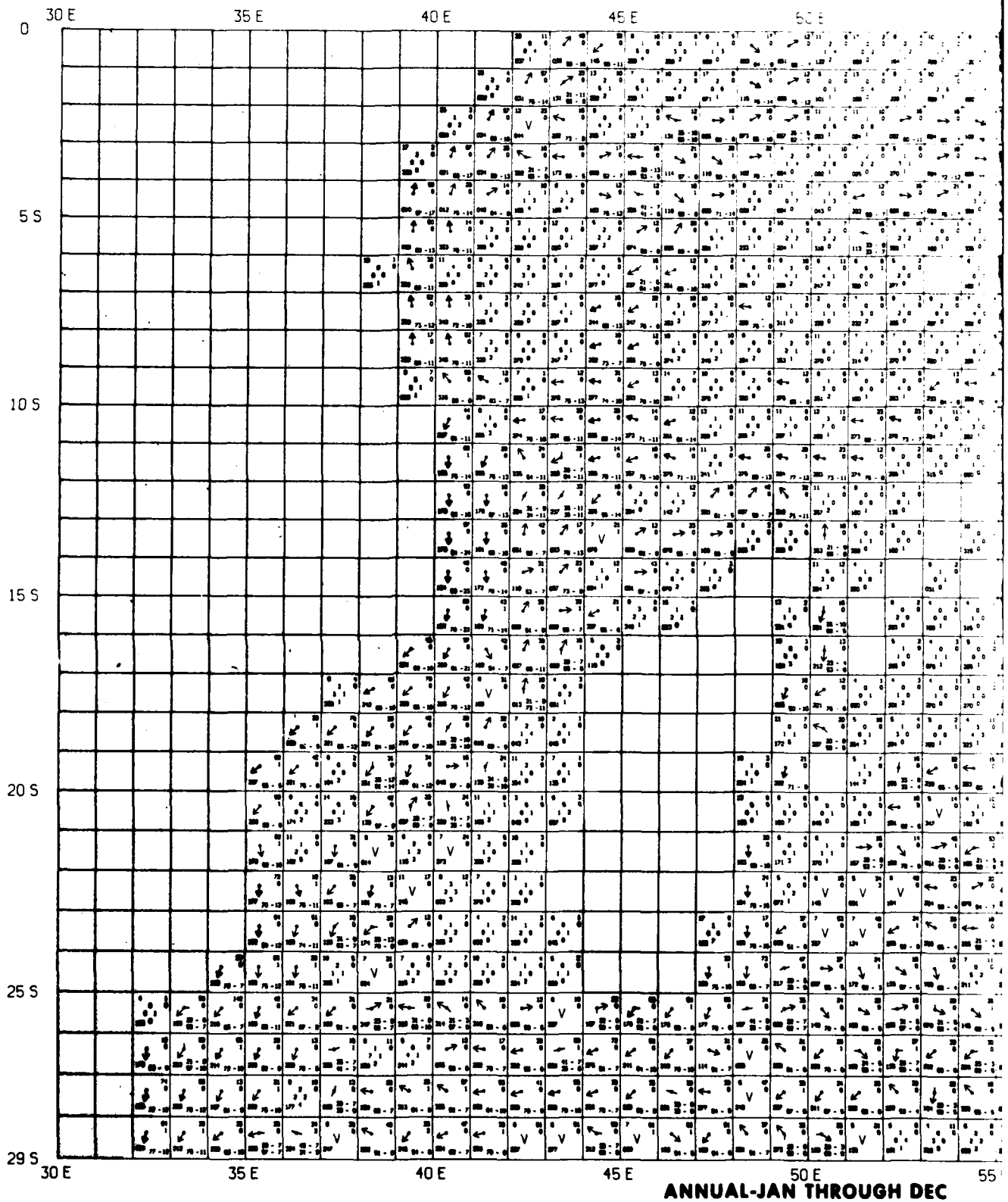
SUMMER-JUL, AUG, SEP,







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45 E

50 E

55 E

60 E

65 E

70 E

0

5 S

10 S

15 S

20 S

25 S

29 S

45 E

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55 E

60 E

65 E

70 E

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SURFACE CURRENTS WEST CENTRAL INDIAN OCEAN INCLUDING MOZAMBIQUE CHANNEL	Final		
7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s)		
Naval Oceanographic Office NSTL Station, MS 39522			
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK UNIT NUMBERS		
Naval Oceanographic Office			
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE		
	October 1977		
	13. NUMBER OF PAGES		
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14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report)		
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This atlas, and the series of which it is a part, is computer generated and automatically plotted. It makes available to user the most recent surface current data collected and will be updated whenever sufficient amounts of data are added to the data file. This and the other atlases are based on a vast quantity of data as compared to the previous manually-compiled editions printed in the mid-thirties.			

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The surface current information is based mainly on ship drift, which is the difference between the dead reckoning position and the position determined by any type of navigational fix. This difference describes the direction and speed of the current.

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